Rare Species (RS)
Sampling Method

EXECUTIVE SUMMARY

The FIREMON Rare Species (RS) method is used to assess changes in uncommon, perennial plant species when other monitoring methods are not effective. This method monitors individual plants and statistically quantifies changes in plant survivorship, growth, and reproduction over time. Plants are spatially located using distance along and from a permanent baseline and individual plants are marked using a permanent tag. Data are collected for status (living or dead), stage (seedling, non-reproductive, or reproductive), size (height and diameter), and reproductive effort (number of flowers and fruits). This method is primarily used for Threatened and Endangered species and uncommon grass, forb, shrub, and tree species of special interest.

INTRODUCTION

When plants become rare, most sampling methods are not effective because the species does not occur in the sampling unit. Therefore, it becomes necessary to follow individual plants in order to determine fire effects for that species. The Rare Species (RS) method was designed to quantify temporal changes in plant survivorship, growth, and reproduction for uncommon, perennial plant species. This method is not effective for rare annual species. First, a permanent baseline is established and baseline length and characteristics about the general sample design are recorded. For each plant, a unique ID number, distance along the baseline, and perpendicular distance from the baseline is recorded. Data are collected for status (living or dead), stage (seedling, non-reproductive, or reproductive), size (height and diameter), and reproductive effort (number of flowers and fruits) for each individual plant.

This method is primarily used when the fire manager wants to monitor changes in Threatened and Endangered perennial plant species and uncommon species of special interest. This method is suited for rare grass, forb, shrub, and tree species that are not effectively monitored by other methods. This sampling method uses attributes of individual plants to assess changes in survivorship, growth, and reproduction over time.

There are many ways to streamline or customize the RS sampling method. The FIREMON three-tier sampling design can be employed to optimize sampling efficiency.
See the sections on **User Specific RS Sampling Design** and **Sampling Design Customization** below.

SAMPLING PROCEDURE

This method assumes that the sampling strategy has already been selected and the macroplot has already been located. If this is not the case, then refer to the FIREMON **Integrated Sampling Strategy** and for further details.

More than any of the other FIREMON methods, the RS method is especially sensitive to the timing of sampling in relation to the phenological stage of the plants being sampled. Plant size, stage and, stem, flower and fruit counts change as the growing season progresses. A monitoring plan that includes rare species sampling and does not take phenological stage into consideration will probably not result in useful data. This topic is covered more thoroughly in Chapter 12 of Measuring and Monitoring Plant Populations (Elzinga and others, 1998). The publication is free and is available for download from the BLM library website:

http://www.blm.gov/nstc/library/techref.htm

Select T.R. number 1730-1.

The sampling procedure is described in the order of the fields that need to be completed on the RS field form, so it is best to reference the RS Field form when reading this section. The sampling procedure described here is the recommended procedure for this method. Later sections

will describe how the FIREMON three-tier sampling design can be used to modify the recommended procedure to match resources, funding, and time constraints. A field-by-field description of the sampled elements is provided in the RS Field Descriptions.

See **How To Locate a FIREMON Plot**, **How To Permanently Establish a FIREMON Plot** and **How to Define the Boundaries of a Macroplot** for more information on setting up your macroplot.

Preliminary Sampling Tasks

Before setting out for your field sampling, layout a practice area with easy access. Try and locate an area with the same species or vegetation lifeform you plan on sampling. Get familiar with the plot layout and the data that will be collected. This will give you a chance to assess the method and will help you think about problems that might be encountered in the field. For example, will you really be able to identify the species of interest once you are in the field? It is better to answer these questions before the sampling begins so that you are not wasting time in the field. This will also let you see if there are any pieces of equipment that will need to be ordered.

Many preparations must be made before proceeding into the field for RS sampling. First, all equipment and supplies in the **RS Equipment List** must be purchased and packed for transport into the field. Since travel to FIREMON plots is usually by foot, it is important that supplies and equipment be placed in a comfortable daypack or backpack. It is also important that there be spares of each piece of equipment so that an entire day of sampling is not lost when something breaks. Spare equipment can be stored in the vehicle rather than the backpack. Be sure all equipment is well maintained and there are plenty of extra supplies such as plot forms, map cases, and pencils.

All RS Field forms should be copied onto waterproof paper because inclement weather can easily destroy valuable data recorded on standard copier paper. Plot forms should be transported into the field using a plastic, waterproof map protector or plastic bag. The day's sample forms should always be stored in a dry place (i.e., office or vehicle) and not be taken back into the field for the next day's sampling.

We recommend that one person on the field crew, preferably the crew boss, have a waterproof, lined field notebook for recording logistic and procedural problems encountered during sampling. This helps with future remeasurements and future field campaigns. All comments and details not documented in the FIREMON sampling methods should be written in this notebook. For example, snow on the plot might be described in the notebook, which would be very helpful in plot remeasurement.

It is beneficial to have plot locations for several days of work in advance in case something happens, such as the road to one set of plots is washed out by flooding. Plots should be referenced on maps and aerial photos using pin-pricks or dots to make navigation easy for the crew and to provide a check of the georeferenced coordinates. We found that it is very easy to transpose UTM coordinate digits when recording georeferenced positions on the plot sheet, so

marked maps can help identify any erroneous plot positions. If possible, the spatial coordinates should be provided if FIREMON plots were randomly located.

A field crew of two people is probably the most efficient for implementation of the RS sampling method. There should never be a one-person field crew for safety reasons, and any more than two people will probably result in some people waiting for critical tasks to be done. The crew boss is responsible for all sampling logistics including the vehicle, plot directions, equipment, supplies, and safety. The crew boss should be the note taker and the technician should perform most quadrat measurements. The initial sampling tasks of the field crew should be assigned based on field experience, physical capacity, and sampling efficiency, but sampling tasks should be modified as the field crew gains experience. Tasks should also be shared to limit monotony.

Designing the RS Sampling Design

There is a set of general criteria recorded on the RS Plot form that forms the user-specified design of the RS sampling method. Each general RS field must be designed so that the sampling captures the information needed to successfully complete the management objective within time, money and personnel constraints. These general fields should be determined before the crews go into the field and should reflect a thoughtful analysis of the expected problems and challenges in the fire monitoring project.

Plot ID Construction

A unique plot identifier must be entered on the RS sampling form. his is the same plot identifier used to describe general plot characteristics in the Plot Description (PD) sampling method. Details on constructing a unique plot identifier are discussed in the **How to Construct a Plot ID** section. Enter the plot identifier at the top of the DE field form.

Determining the Sample Size

The size of the rare species population ultimately determines the length of the baseline from which the individual plants are located. The baseline length is recorded in Field 1on the RS field form. If the population is divided along several patches, several baselines can be established. The size of the rare species population also determines the number of individuals sampled. We recommend sampling 25 individuals within the population; this should be sufficient for most studies. However, there are situations when more individuals should be sampled and in these cases the project objectives should identify the sampling intensity. The FIREMON RS field form and data entry screen allow an unlimited number of individuals to measured per baseline. If the population is smaller than 25 individuals, measure all individuals. This will then be a census rather than a sample, and a statistical analysis will not be necessary.

Conducting RS Sampling Tasks

Establish the Baseline for Locating Individual Plants

The baseline serves as a georeferenced starting point for relocating individual plants. If there are other FIREMON methods implemented at the same sample site then, as much as possible, the plots should be set up so that they correspond with one another. See **How To Establish Plots with Multiple Methods**. In most cases, this will not be possible when monitoring rare plants. Once the rare species population is located, a permanent baseline is set up as a reference from which you will locate individual plants. On flat areas, the baseline runs from south to north with the 0-foot (0 m) mark on the south end. On slopes, the baseline runs upslope with the 0-foot (0 m) mark on the bottom (down slope) end. The length of the baseline will be determined by the size of the rare species population.

Locating Individual Plants

Locate individual plants within the rare species population by running a tape perpendicular to the baseline to the plant. If the rare species population being sampled is to the right of the baseline when looking up hill (or, north on flat ground) then distances to plants are recorded as positive (+) numbers and distances to plants to the left are recorded as negative (-) numbers. Because the distance along the baseline and the distance from the baseline will be used to relocate plants in successive years, it is essential that these measurements are exact and the lines are perpendicular (figure RS-1). Measure the distances to the nearest 0.1 foot (0.02 m)

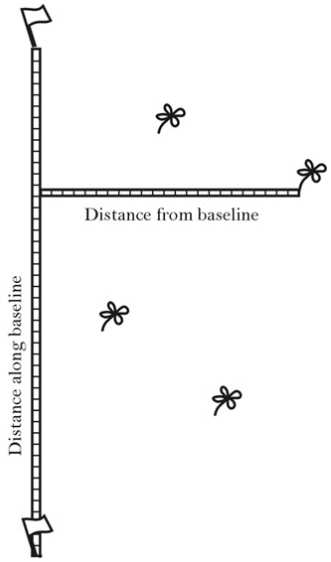

Figure RS-1. Measuring the location of rare plants. It is critical that the distance locating each plant – along and from the baseline – be accurately measured and that the measuring tapes are perpendicular.

Tagging the Individual Plants

Individual plants need to be permanently tagged with a unique plant number. If the plant is woody (shrub or tree) the tag can be attached to the plant. If the plant is herbaceous (grass or forb), the tab should be anchored in the soil adjacent to the plant in standard location (for example, directly down slope of the plant). Because these tags will uniquely identify the individual plant, it is essential that they be located in a manner that will eliminate any confusion between individuals.

Rare Species Sampling

Plant Identity

First enter the species code in Field 2 on the RS field form. FIREMON uses the NRCS Plants species codes, however you may use your own species codes. See **How to Customize Plant Species Codes** for more details.

To uniquely identify each individual of the rare species, enter the plant number in Field 3, distance along baseline in Field 4, and distance from the baseline in Field 5 in the RS field form.

Status

Next enter the plant status in Field 6 on the RS Field form. Status describes the individual plant as live or dead using the following codes:

L – Live: plant with living tissue
D – Dead: plant with no living tissue visible
NA – Not Applicable

Plant status is purely qualitative but determines post-burn survivorship and population health. Use care in determining plant status during the dormant season.

Stage

Enter the plant species stage in Field 7 on the RS Field form. Stage describes the individual plant as a seedling, non-reproductive adult, or reproductive adult.

S – Seedling: plant less than 1 year old
NR – Non-Reproductive adult: plant one year old or older without flowers or fruits
R - Reproductive adult: plant one year old or older with flowers or fruits

Plant stage is also qualitative but provides information on plant growth and reproduction and population health. Use care in determining plant reproductive status during the dormant season.

Size

Size information provides data on growth rates and population vigor. There are four measures of plant size that will be entered on the RS field data form: two diameter measures, maximum height, and number of stems.

For grasses, forbs, shrubs, and tress less than 1 in. (2 cm) DBH, measure the diameter of the plant (canopy) at two places. First, measure the widest part and record the diameter in Field 8. Make a second measurement at a right angle to the first and record in Field 9. Make both measurements in inches (cm) to the nearest 0.1 inch (0.2 cm).

For trees at least 1 inch (2 cm) DBH, record DBH in Field 8. Measure the maximum height of the plant in feet (m) and record in Field 10 to the nearest 0.1 feet (0.03 m). For more information on measuring plant heights see **How to Measure Plant Height**.

Regardless of the plant size, in Field 11 record the number plant stems for the individual you are measuring. Use care in determining individual plants when measuring size.

Reproduction

Flower and fruit counts provide data on reproductive rates and population viability. Count the number of flowers and fruits on the plant and record in Fields 12 and 13, respectively, of the RS field data form.

Precision Standards

Use these precision standards for the RS sampling.

Table RS-3. Precision guidelines for DE sampling.

Component	Standard
Distance along baseline	±0.1 ft/0.03 m
Distance from baseline	±0.1 ft/0.03 m
Maximum diameter	±0.1 in./0.2 cm
Diameter 2	±0.1 in./0.2 cm
Height	±0.1 ft/0.03 m
Stems	±3 percent total count
Flowers	±3 percent total count
Fruits	±3 percent total count

SAMPLING DESIGN CUSTOMIZATION

This section will present several ways that the RS sampling method can be modified to collect more detailed information or streamlined to collect basic information.

Recommended RS Sampling Design

The recommended RS sampling design follows the Recommended FIREMON Sampling Strategy and is listed below:
Number of Individual Plants Sampled: 25
Record: Status and Stage
Measure: Maximum Diameter, Diameter at right angles, Height
Count: Stems, Flowers, Fruits

The baseline length should be adjusted according to the size of the rare species population being sampled.

The number of individual plants sampled should be adjusted according to the appropriate methods in the "How To" section of the FIREMON manual.

Streamlined RS Sampling Design

The streamlined RS sampling design follows the Simple FIREMON sample strategy and is designed below:

Number of Individual Plants Sampled: 15
Record: Status and Stage
Measure: Maximum Diameter, Height

The baseline length should be adjusted according to the size of the rare species population being sampled.

The number of individual plants sampled should be adjusted according to the appropriate methods in the "How To" section of the FIREMON manual..

Comprehensive RS Sampling Design

The comprehensive DE sampling design follows the Detailed FIREMON sampling strategy and is detailed below:

Number of Individual Plants Sampled: 25 per stage (25 seedlings, 25, non-reproductive adults, and 25 reproductive adults) adding additional plants to the stage categories as individuals die or move into another stage (for example seedling to non-reproductive adult).
Record: Status and Stage
Measure: Maximum Diameter, Diameter at right angles, Height

Count: Stems, Flowers, Fruits, Seeds, Vegetative Reproduction

These data could be used to conduct a population viability analysis; see Elzinga and others (1998) or a detailed discussion on this topic.

The baseline length should be adjusted according to the size of the rare species population being sampled.

User-specific RS Sampling Design

The user can modify the RS sample fields a number of ways in order to make sampling more efficient and meaningful for local situations. This will usually mean adjusting the number of individuals sampled as needed for the specific task. Use the Metadata form to record any changes in sampling methods that are modified from the standard or to remark on any other RS matter that needs to be explained or defined for subsequent sampling and data use.

Sampling Hints and Techniques

Examiners must be able to identify the target plant species and identify individual plants. It can be difficult to distinguish individual plants for some species such as sod-forming grasses. If individual plants are difficult to identify, guidelines should be determined before sampling as to what constitutes the individual counting unit. Some examples include counting individual stems in aspen communities, culm groups in rhizomatous grasses, and flowering stems for mat-forming forbs. However, the counting unit chosen to monitor should reflect a real change in the plant community.

Measuring tapes come in a variety of lengths, increments, and materials. Examiners should choose English (metric) tapes for this method and select a tape that is at least as long, or a little longer, than the baseline length being sampled. Steel tapes do not stretch and are the most accurate over the life of the tape. Steel is probably the best choice where re-measurement in exactly the same place each time is important. Cloth and fiberglass tapes will stretch over the life of the tape, but are easier to use than steel tapes since they are lighter and do not tend to kink.

The sampling crew may encounter an obstacle, such as a large rock or tree, along one of the transect lines that interferes with the quadrat sampling. If that happens offset using the directions described in **How To Offset a Transect**.

Because the purpose of resampling is to determine change over time, it is essential that the plots are resampled when then plants are in the same phonologic condition as when they were originally sampled. Typically this means resampling on the same date as when you originally sampled. If you do not resample when the plants are in the same phonologic condition, then you may be documenting annual growth cycles rather than fire effects.

When entering data on the RS field forms, examiners will most likely run out of space on the first page. The form was designed to print one copy of the first page, and several copies of the

second page. The second page can be used to record more plant species on the first three transects or to record data for additional transects. The second page of the field form allows the examiner to write the transect number on the form. This allows the examiner to design the form to accommodate the number transects sampled. Print out enough pages to record all species on all transects for the required number of intercepts.